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To Determine The Strength of The Train Buffer End stop

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Issue; 1

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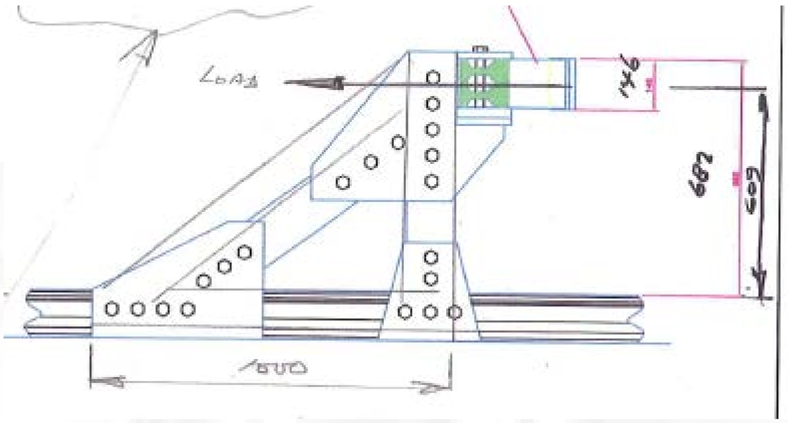

Description

This report is to complement report XXX-XX-000XX, part 1, and XXX-XX-000XX, part 2. Your Company has asked to determine the mechanical integrity of the train buffer end stop structure.

Requirements and Assumptions

1. The structure will be made from 100 x 100 x 10mm box section (see Appendix A).
2. The material of the box section is S235JRH.
3. The tray in the structure, see Figure 1, is loaded with 6.7tonne. The force applied on the structure is 6.7tonne.

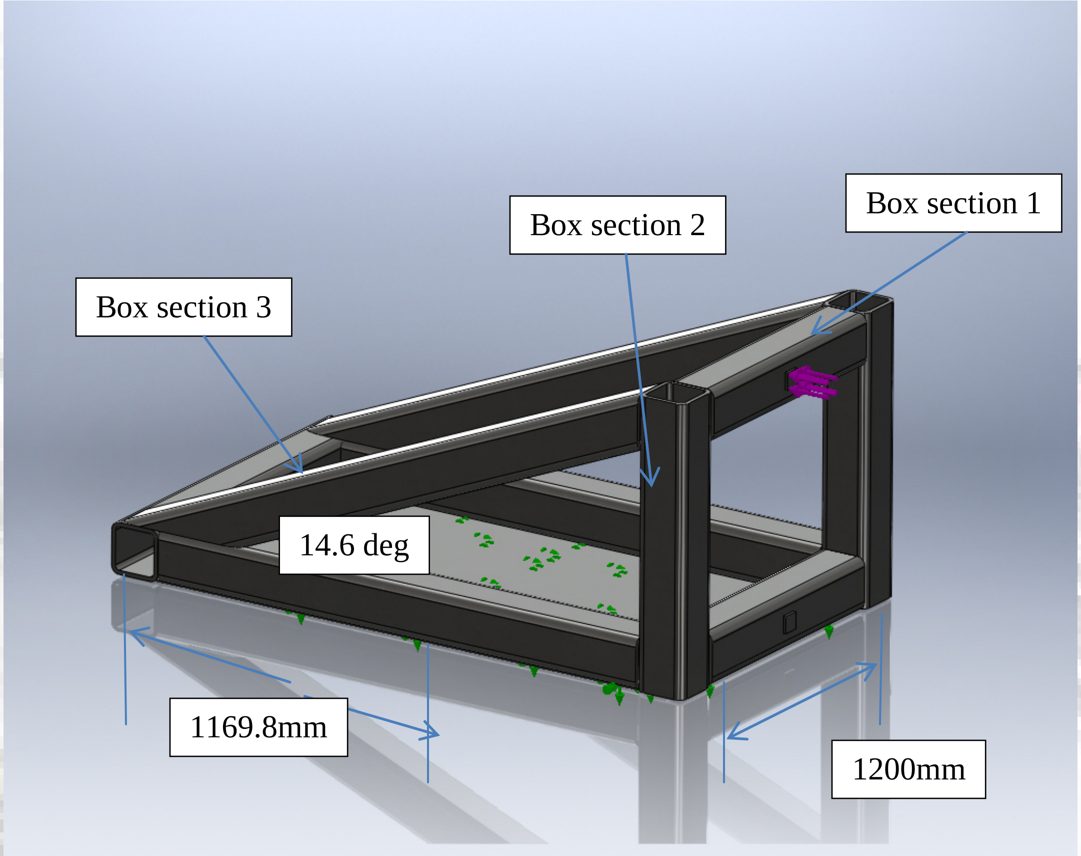

Figure 1 Shows the end stop barrier, loaded with 6.7tonne concrete blocks, and 6.7tonne horizontal force applied on the top beam.

Calculations

- **Stresses in box section 1**

From the technical sheet in Appendix A
The area of the rectangular section = A = 34.9 x 10^2mm^2
The young module of the cross section area = Z = 92.4 x 10^3mm^3
The force applied on box section 1 = 6.7tonne = 65.8kN
The bending moment which is applied on box section 1 = 65.8 x 0.6m = 39.5kN.m

The bending stress in box section 1 = $(39.5 \times 10^3)/(92.4 \times 10^3)$ = 0.42MPa
The shear stress in box section 1 = $(65.8 \times 10^3)/(34.9 \times 10^2)$ = 19MPa
The average stress, Von Misses, in box section 1 = $((0.4)^2 + (3) .(19)^2)^{0.5}$ = 33MPa

- **Stresses in box section 2**

The applied force = 65.8kN/2 = 32.9kN
The bending moment on box section 2 = 32.9 x 0.609 = 20kN.m
The bending stress in box section 2 = $(20 \times 10^3)/(92.4 \times 10^3)$ = 0.2MPa
The shear stress in box section 2 = $(32.9 \times 10^3)/(34.9 \times 10^2)$ = 9.42MPa
The average stress, Von Misses, in box section 2 = $((0.4)^2 + (3) .(9.4)^2)^{0.5}$ = 16.2MPa

- **Stresses in Box section 3**

The compression stress in box section 3 = $(32.9 \times \cos(14.6)) /(34.9 \times 10^2)$ = 9.2MPa

- **FEA work on the structure**

The structure is fully constrains at the base as shown in Figure 1. Figure 2 shows that the maximum stress in the structure is in the region of 70MPa. The yield point of the material is 340MPa, therefore the safety factor for box section1 is 4.8. Figure shows that the maximum displacement in the structure is 0.5mm.

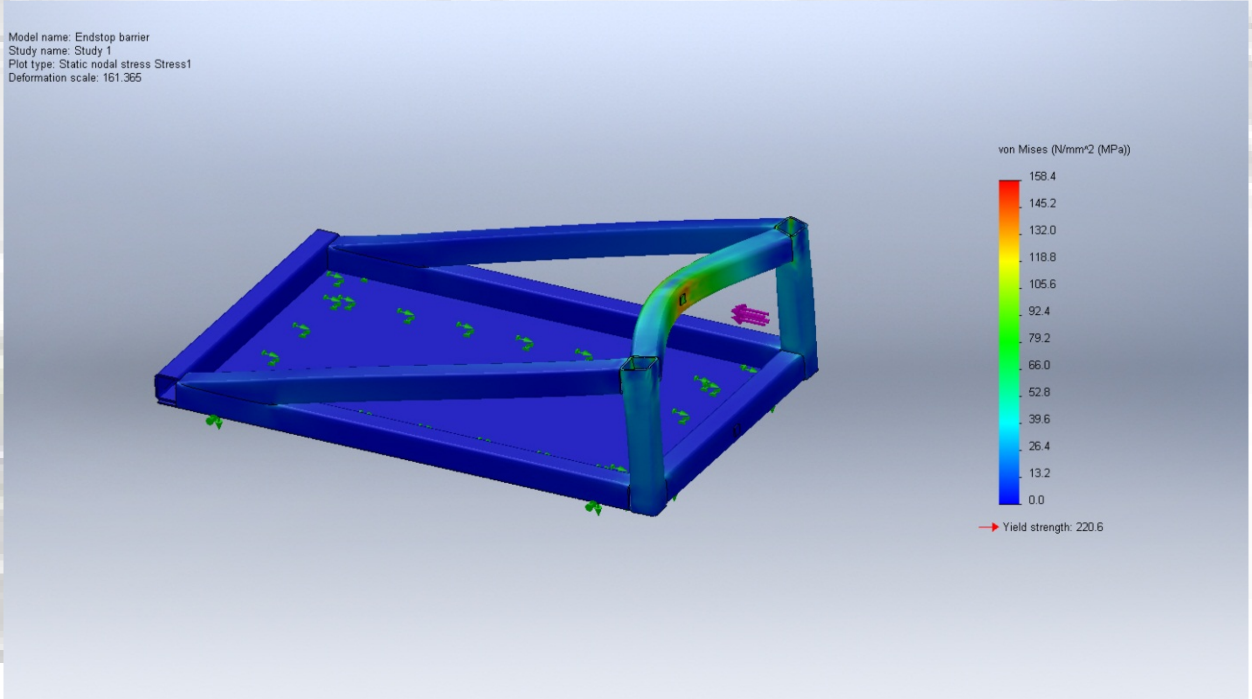

Figure 2 Shows the stress distribution in the structure.

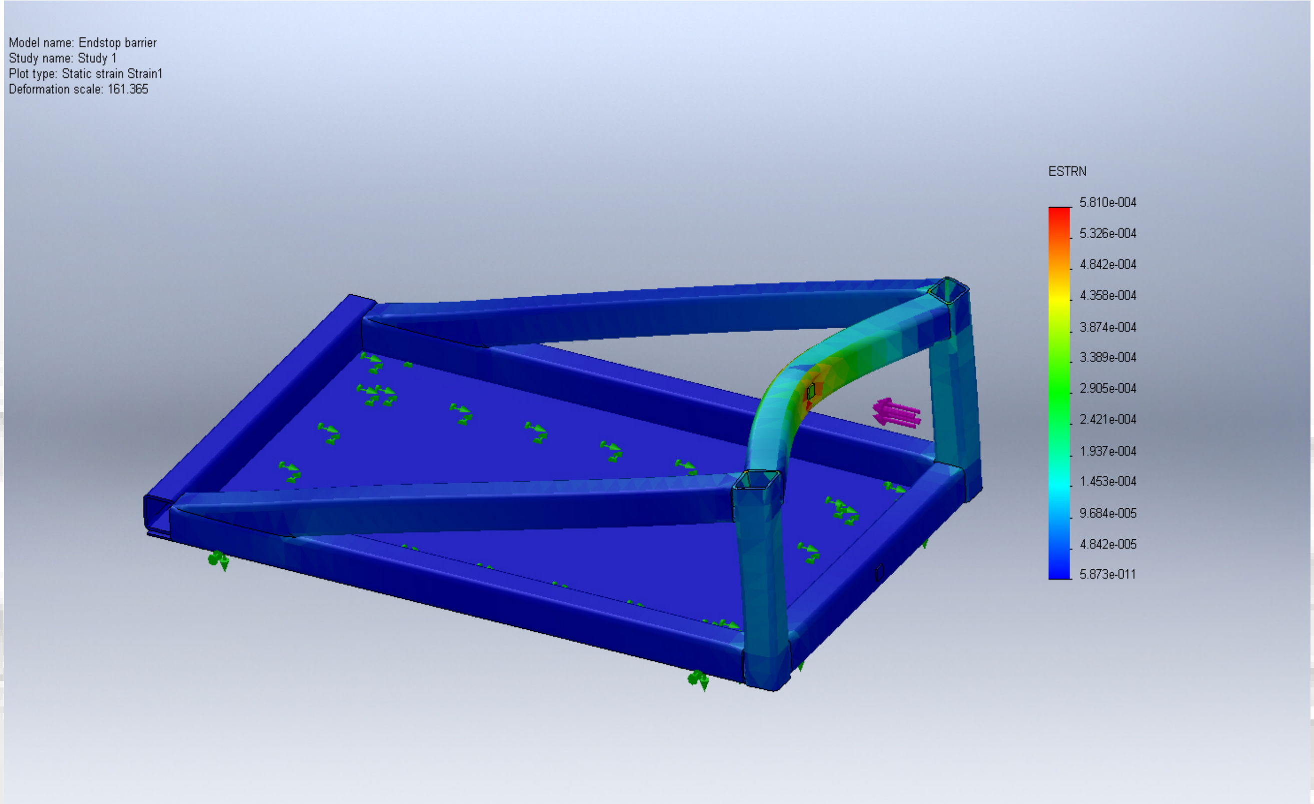

Figure 3 Shows the displacement distribution in the structure.

- **Strength on the welds at the ends of box section 1**

The height of the weld = h = 10mm, b = 100mm, d = 100mm
The area of the weld = Aw = 1.414.h.(b+d) = 1.414.(10).(200) = 2828mm^2
Iu = $(d^2/6).(3b+d) = ((100)^2/(6)).(3(100) + (100)) = 666666.6\text{mm}^4$
The area moment of inertia for the weld = 0.707. h.Iu = 0.707 x 10 x 666666.6 = 4713333.0mm^4
The young module of the area = 4713333.0/50 = 94267mm^3
The bending moment in the weld = $(39.5 \times 10^6)/(94267).(2)$ = 209.5MPa
The shear stress in the weld = $(92.4).(10^3)/(2).(1696.8)$ = 27.22MPa
The average stress, Von Mises stress = $((209.5)^2 + (3).(27.2)^2)^{0.5}$ = 215MPa

Conclusions

This calculations show that the structure with 6.7tonne as stability weight is adequate to resist a 6.7tonne horizontal force. If the weld height is 10mm, the strength of the weld at the most venerable location in the structure is strong and adequate for the application, provided that the specification of the weld material is to a yield point higher than 400MPa.
Four M12 bolts can be used at each corner to fix the structure to the ground, this should increase the stability of the structure against the rotational force.